REVIEW ARTICLE

Sustainable Finishing of Cotton Fabric Using Eco-Friendly Natural Products

Usha Sayed*, Swati Korgaonkar
Department of Fibres and Textile Processing Technology, Institute of Chemical Technology,
Nathalal Parek Marg , opposite khalsa college , Matunga, Mumbai-19, India

ABSTRACT: India is the second most populous country in the world with a huge requirement for healthcare services. The growth in the healthcare market is driven by the higher income of the patients who also have greater healthcare awareness, especially with the increase in communicable and non-communicable diseases. The market is still open and has ample space for the new comers in the allied area. Cotton is the king of fiber but the only drawback is attack by the fungus and the bacteria in the wet condition or otherwise leading to poor shelf life. Hence cotton fabrics with antimicrobial properties had attracted considerable attention for both hygiene and durability in humid conditions. This is due to their potential applications in healthcare and medical sector. In the present review various methods researched and reported the cotton fabric finish with antimicrobial agents to be effective against various kinds of viruses and bacteria and also fungus. The chemicals used namely organic biocides, quaternary ammonium compounds, organ silicones are not eco-friendly and sometimes toxic in nature and there has been immense research to replace these chemicals with sustainable and biodegradable products.

In recent years innovative approach namely green aspects are seen as an alternative for the above chemicals. Thus herbal extracts can be used for treating and finishing the cotton fabric to achieve antimicrobial effect and which is sustainable. Moreover, the growing demand for herbal products has led to the idea of developing healthcare textile products. The present examination aims at developing an eco-friendly antibacterial finishing agents from plant extracts. Some plants were identified, selective and screened for their antibacterial activities. Thus eco-friendly clothing is created from resources that are environmentally friendly and sustainable. The present paper evaluates the overall reports on herbal extracts and plants extracts used for imparting a finish or a coating on cotton fabrics.

KEYWORDS: Sustainability, Cotton fabric, Herbal Extracts, Antimicrobial, Health care

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1. INTRODUCTION

India is known to be second most populous country in the world. The amenities and facilities are not self sufficient for a huge population. Especially in the healthcare sector because of the ever-increasing population the ratio of number of beds: no of patients is approximately 5:1 leading to major healthcare problems in the country. There are large number of communicable as well as non-communicable diseases which are been spread worldwide. Some are being treated while the other are just being taken precautionary care. The hygiene fabric is being developed to take care at its precautionary stage. The microbial attack to the body can be prevented if there is a layer of protection covered over it basically the textile substrate. Organic cotton is widely being used due to its biodegradability and durability. Here in this present study we will mainly focus on organic cotton substrate and its advancement in the finishing of antimicrobial attack using herbal extracts. The microbial attack is more prone to cotton fabric and hence imparting antimicrobial properties to cotton by antimicrobial and sustaining durable finishing is a challenging task [1].

Organic cotton fabric can be used in healthcare and medical textiles as implantable, non-implantable, hygiene products as well as protective textiles. Sustainability using the green approach is in demand in recent times. There is shift in market from higher consumption of hazardous chemicals towards the sustainable products. Chemicals such as quaternary ammonium compounds, organic silicones, biocides are hazardous in nature. Replacement of these chemicals is essential for protecting the environment. Studies have shown that the herbal extracts are widely been used as a replacement of these chemicals. The antimicrobial finishes are given through commonly used herbal

**Corresponding Author: ushatxt@gmail.com*
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extracts like chamomile tea leaves, turmeric, neem leaves and many more [[2],[3]].

Antimicrobial textiles with improved functionality find a variety of applications such as health and hygiene products, specially the garments worn close to the skin and several medical applications, such as infection control and barrier material. Hygiene and medical textiles production has increased worldwide with US $ 920 billion 2018 and will be expected to continue up to 1230 US $ BY 2024. The communicable disease continues to remain a threat for major public health problem for both national and international health security. These outbreaks will continue to challenge public health, requiring high level of readiness in terms of early detection and rapid response. Resistance towards the microorganism is one of the biggest health challenges facing humanity that must be tackled with all seriousness.

The main aim of this review is to provide a sustainable product for the development of hygiene fabric using herbal extracts. The poor sanitation problem faced by the countries like India is a major reason why there is an excessive need for the production of the product.

The objective hence can be defined as to control the growth of micro-organisms, to protect from viral infections caused by pathogenic bacteria as well as to save the textile materials from unexpected staining or quality deterioration. In the initial era, the rural population of India used to depend upon the Ayurveda medicinal herbs for treating various diseases. Even though it was not 100 % efficient in results but it never gave any side effects according to the studies. There were many endemic diseases which were caused in the history of India mainly due to flies, mosquitoes, rodents, microorganisms which has lead to massive deaths in the past.

Diseases are mainly increased due to inadequate and unsafe water, lack of sanitation and poor hygiene behaviour which is a complex issue in our society. The hygiene related outbreaks in endemic areas are greatly enhanced by human behaviour with regards to practice of healthy hygiene. Poor hygiene behaviour is a huge burden in developing countries causing illness and death. According to the study it is been found those children's and old elderly are more susceptible to diseases due to their low immunity. Special care should be taken to improve the same [4].

Herbal extracts is found to be a good alternative to be used for the antimicrobial finishes of the cotton fabric. For example, the antibacterial activities of sage essential oils exhibited resistant against bacteria. It has been proven that the sage essential oils are better than traditional antibiotics. From the literature review results, it is clear that, sage plants consist of largest number of bioactive compounds, which have a wide range of organic biological, activates. There can exhibit anti-inflammatory, antioxidant, antimicrobial and antiviral effects [[5],[6]].

The bioactive compounds which are present in excess in the herbal are mainly responsible for the antimicrobial resistance of the substrate. Plants possess a wide variety of secondary metabolites which have been found in vitro to have antimicrobial properties. The use of natural products for antimicrobial finishing of textiles has opened up new avenues in the field of technical textiles. Although there are many natural sources rich in antimicrobial agents, the study on their use in textiles is very limited and not documented. There is plenty availability, green approach, low toxicity, biocompatibility and eco-friendly nature are accepting popularity all the world-wide for their utilization in textiles. In addition, there are a lot of requests in textile marketing places that provides comfort-ability as well as other functional properties. For that reason; scientists in textiles are studying the application methods possible of the plants containing bioactive agent in producing highly functional value-added and more attractive textile substrates. Insect-repellent, deodorizing/aroma, UV-protection, antimicrobial and flame retardant are some of the new properties, which have been acquired recently on textiles [7].

Advancement in using sustainable product for development of antimicrobial textiles

Ever increasing demand of sustainability researchers are have started using extracts of plants from various parts like roots, leaves, stem, fruits etc. The authors generally say that the phytochemicals present in the herbs will interact and enhance the therapeutic effects of the herbs and dilute the toxicity.

The herbal extracts due to its higher advantages and low cost will be used majorly according to the future aspects. There collection and extraction process of herbal plants seem to be easy if we are dealing with the rural people as the herbs are found in excess in the forest regions. As Asian are gifted with the beauty of nature, the forest area has a self-sufficient number of herbs and can be used for its beneficiary. In this present study we are mainly focusing on how the rural people can be benefited with these herbal and hygiene fabrics and how the resources can be used by them for their benefits [8],[9].

Method of Extraction and collection of the herbal extracts:

According to literature surveys the herbs are been collected and then ionized with distilled water to

remove the dirt and impurities and then dried in the oven at 105^0 or even sun dried in most cases. After drying the herbs are been crushed in the mixture or mortar and pester and finely chopped into powder form. This powder is then being examined and screened for various characterizations like XRD, SEM, GCMS, IR, EDX. So that the groups responsible for the functional properties while further possibility of usage can be characterized through this screening.

Further the prepared powder is being used for extraction of herbal solution where the phyto constituents are been extracted in the solution form and this solution is been used for application on the substrate. The extraction method has already been explained that there are two methods the aqueous method and the Soxhlet method. As we can see from the Fig 1 the schematic representation of the process of extraction and how it takes place [9],[10].

The extracted solution should be applied on the substrate for its functional finish but there should be no color change onto the substrate or quality detoriation. The physical parameter like shelf life, color, order, viscosity, boiling point etc of the prepared herbal solution should also been checked to know whether the product is suitable and what is storage range of the product. As seen from the literature survey the authors have mainly applied the herbal extracts on cotton or synthetics like polyester, polypropylene, viscose etc as well as on Nonwovens but the major problem is the biodegradability of the fabric and the durability of the substrate. Hence in our paper we would like to approach that Organic cotton has a major advantage and hence replacement of cotton or other substrates can be done easily. Organic cotton has a durability as well as biodegradability which serves our purpose as per our future aspects are concerned. The textiles or garments has its healing value depended upon the principle of touch. The human coming in contact with herbal cloth, toxins are loosen by the body and its metabolism is enhanced. This is the basic mechanism behind the herbal cloth. As the cloth is herbal it has resistance towards the pathogens and bacteria which prevents them from various communicable diseases. There are many herbs available in nature which has inherent usage for heart diseases as well as diabetes which were once a threat for humans to find a cure. For example, the plants like Magnolia Champaca (champa), Hibiscus rosa-sinensis, mimosa pudica where used for Diabetes cure. Traditionally the herbs were used to cure many skin diseases which were used in ancient history of India like the turmeric, neem, sandalwood, aloe Vera [[19],[21],[23]]. Cuscus grass is good for asthma patients, sandalwood; with its mild fragrance has a soothing effect that helps in fighting stress. *Katha*, catechu is used for treatment of parasitic infestation and itching. Textiles mainly nonwovens have a wide usage in medical textiles like medical gowns, surgical masks, gloves, wipes, bandages etc which has also found to be treated with various herbs according to the literature. The absorption and surface characteristics is also very important factor while applying any product on to the substrate. The application is mainly in the solution form applied to the substrate. The solution can be either micro, Nano or macro scale. As seen from our various studies that Nano structure due to their specific geometry and its targeted action is majorly used for application purposes. We in the present study have come across various aspects where Nano emulsion of these herbal extracts is found to be more effective to reach the target and hence the resistance is observed to be more in case of Nano emulsions instead of micro and macro emulsions. Nano emulsions due to its small size 1- 100 nm has a high surface to volume ratio. Their specific targeted action has perhaps made it more available for various applicability and function [11]-[13].

As seen from previous research the chemical which is used for antimicrobial activity can be applied to the textile material by exhaust, pad-dry-cure, coating, spray and foam techniques. The substances can also be applied by directly adding into the fibre spinning dope [27],[29]. Various methods for improving the permanence of the finish such as: In solubilisation of the capable substances in/on the fibre; Apply the resin on the fibre and improve the adhesion by cross linking agents; With the help of microbial agents protect the fibre matrix by micro covering; Application of finish on the fibre surface; Modifying the chemical structure of the fibre by forming the covalent bond; and Application of Nano polymers, homo polymers and/or copolymer on to substrate [14],[15].

Application of herbal extracts on fabric

There is a lot of data provided on the application of the herbal products onto the substrate. As observed from the literature the treatment of cotton fabric by various herbal extracts were hence noted. The cotton fabric was treated with the product by either of two extract methods (aqueous or Soxhlet extract method). The treatment was done in absence or presence of eco-friendly crosslinking agent. The cotton fabric was first treated with herbal extract by 2 dip method. The fabric was immersed in the extract herbs for 30 min and dried. Cotton fabric was padded dip and nip in the finishing formula and then the treated fabric was dried at 80^oC for 5 min. and cured at 120^oC for 3 min. The finished cotton fabric was subjected for the antimicrobial assessment [16],[17]. There are two methods by which the assessment for antimicrobial

resistance of the textile substrate is been checked AATCC 100 and AATCC 147 [4].

According to a feasible requirement of any antimicrobial product the quality of the textile substrate should not degrade. So, evaluation of physical properties of finished textile substrate is necessary.

CONCLUSION

Clothing which are eco-friendly and are made from herbal and sustainable products are been raised more in the market. Due to its availability of resources and its cost lost benefits. The product's total life span as well as its impact on the planet is been considered by most of the national and multinational companies. Manufacturing companies are leveraging this opportunity to position themselves favorably in the global market of medical textiles to gain the confidence of customers and expand their geographical presence especially in the developing economies. The rural population is not well equipped with proper hygiene and sanitation facilities are their livelihood so there is a need for an herbal hygiene fabric which will act as a protective layer and can fight against the microbial attacks and pathogens for their safety and wellbeing. Although plenty of research has been carried out on herbal resources and its usage on textile substrate but there are still many aspects which are not been well studied, like comfortability, biodegrability as well as durability of the herbal finish is still lacking for commercialization of the product.

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